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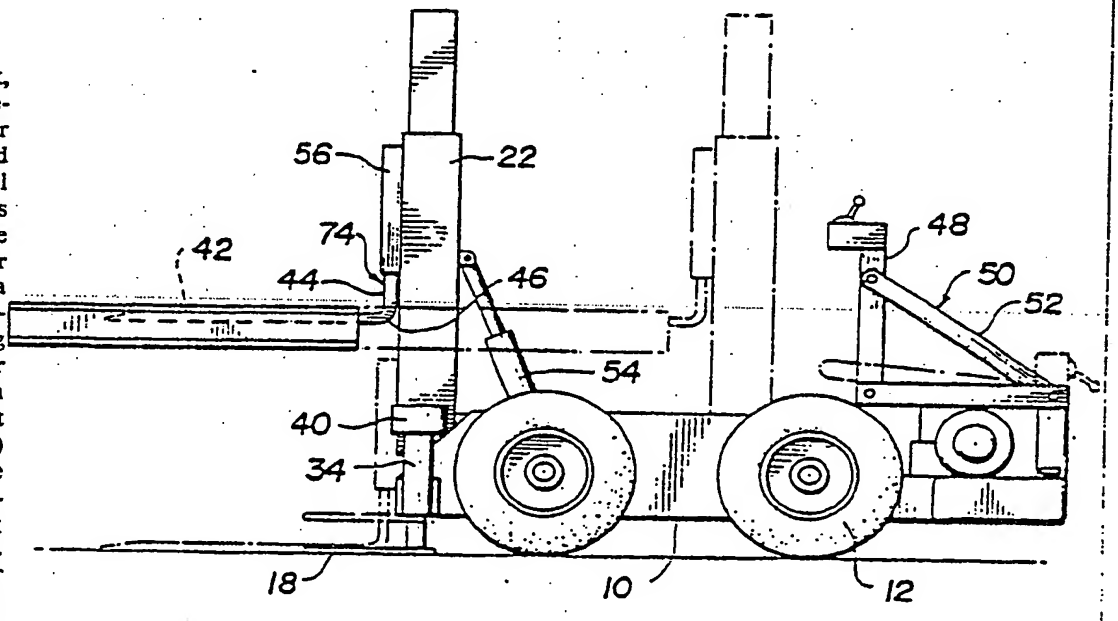
(57) Abstract

A lift and carry truck, such as a forklift truck, is designed to prevent tip over when lifting a heavy load outside the truck's weheel base. Once lifted the load is shifted to a point near the truck's center of gravity for transport. The truck has a body (10 or 310) and a plurality of ground engaging transport wheels (12, 314 or 318) which define a polygon of normal stability. A lift and carry device (14 or 300) is movably mounted on the body (10 or 310) being driven by drive (16 or 316) back and forth between a lift position in which the center of gravity of the combined load and truck is or may be outside the polygon and a carry position in which the center of gravity of the combined load and truck is within the polygon of normal stability. At least one outrigger stabilizer (18 or 36) mounted on the body (10 or 310) is moved by drive mechanism (34, 104, 108 or 308) back and forth between a stabilizing position in which it engages the ground outside the polygon of normal stability and a transport position in which the stabilizer (18 or 306) is retracted and does not interfere with movement of the lift and carry truck. The lift and carry truck is collapsible for storage under a cargo truck (200) for transportation to a work site.



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LIFT AND CARRY TRUCK

Technical Field

This invention relates to lift and carry trucks, such as forklift trucks. In particular, it relates to (1) means for preventing the lift and carry truck from tipping over when it picks up a heavy load outside its wheel base and (2) means for stowing the lift and carry truck under a cargo truck for transportation to a work site.

Background of the Invention

Lift and carry trucks, such as forklift trucks, are frequently called upon to lift heavy weights which are initially located next to the truck and to move the weights into a carry position over the wheel base of the truck. If the weight of the load is heavy enough, the center of mass of the combined load and truck can be outside the polygon of normal stability, or wheel base, of the truck during the initial stages of the lifting operation, resulting in the truck's tipping over towards the load. In order to avoid such tip-over, conventional practice is to mount a massive counterweight on the truck body at the opposite end from the load lifting means. The counterweight, however, adds greatly to both the capital and operating costs of the truck. Moreover, the additional weight of the truck due to the counterweight makes it impractical in many applications to transport the lift and carry truck on a cargo truck for use in loading and unloading the cargo truck at facilities where lift and carry trucks are not available.

Objects of the Invention

It is, therefore, a general object of this invention to provide a lift and carry truck which does not suffer from the foregoing defects of the prior art.

It is a particular object of this invention to provide a lift and carry truck in which a stabilizer can be extended outside of the polygon of normal stability to provide support for a load being lifted onto the truck.

It is another object of this invention to provide apparatus for conveniently and securely stowing a lift and carry truck beneath a cargo truck.

Other objects and advantages of this invention will become apparent as the description of the embodiments thereof progresses.

Brief Summary of the Invention

The foregoing objects of this invention are realized by a lift and carry truck which comprises a body, a plurality of ground engaging transport wheels which define a polygon of normal stability, a lift and carry device mounted on the body, means for moving the lift and carry device back and forth between a lift position in which the center of gravity of the combined load and truck is or may be outside the polygon of normal stability and a carry position in which the center of gravity of the combined load and truck is within the polygon of normal stability, at least one outrigger stabilizer mounted on the body, and means for moving the stabilizer back and forth between a stabilizing position in which it engages the ground outside the polygon of normal stability and a transport position in which the stabilizer is retracted and does not interfere with movement of the lift and carry truck.

Brief Description of the Drawings

Figure 1 is a schematic side view of a first embodiment of the present invention.

Figure 2 is a top plan view of the first embodiment of the present invention.

Figure 3 is a view along the lines 3-3 in Figure 2 showing the lift and any truck in the lift position.

Figure 4 is a view similar to Figure 3 except that it shows the lift and any truck in the carry position.

Figure 5 is a fragmentary side view of the first embodiment showing the first embodiment in its collapsed, storage position.

Figure 6 is a view along the lines 6-6 in Figure 3.

Figure 7 is a front view of the first embodiment.

Figure 8 is a view along the lines 8-8 in Figure 7.

Figure 9 is a perspective view of the first embodiment in use.

Figure 10 is a fragmentary side view of a second embodiment of the present invention.

Figure 11 is a schematic side view of a third embodiment of the present invention in the lift position.

Figure 12 is a schematic side view of a fourth embodiment of the present invention in the lift position.

Figure 13 is a schematic side view of a fifth embodiment of the present invention.

Figure 14 is a schematic side view of a sixth embodiment of the present invention.

Figure 15 is a schematic side view of a seventh embodiment of the present invention.

Figure 16 is a view along the lines 16-16 in Figure 15.

Figure 17 is a view of the seventh embodiment with the spar raised.

Figure 18 is a schematic view of an eight embodiment of the present invention.

Figure 19 is a view along the lines 19-19 in Figure 18.

Figure 20 is a schematic view of a ninth embodiment of the present invention with the spar lowered.

Figure 21 is a schematic view of the ninth embodiment with the spar raised.

Figure 22 is a schematic side view of a tenth embodiment of the present invention with the forklift lowered.

Figure 23 is a schematic view of the tenth embodiment with the forklift raised.

Figure 24 is a view along the lines 24-24 in Figure 22.

Figures 25-27 are highly schematic illustrations of the mode of operation of the tenth embodiment.

Figure 28 is a schematic side view of an eleventh embodiment of the present invention.

Figure 29 is a schematic side view of a twelfth embodiment of the present invention.

Figure 30 is a fragmentary bottom plan view of a thirteenth embodiment of the present invention.

Figure 31 is a fragmentary front view of a fourteenth embodiment of the present invention.

Figure 32 is a fragmentary side view of the fourteenth embodiment.

Figure 33 is a schematic side view of a fifteenth embodiment of the present invention.

Figure 34 is a view along the lines 34-34 in Figure 33.

Figure 35 is a fragmentary top plan view of the fifteenth embodiment.

Figure 36 is a schematic side view of a sixteenth embodiment of the present invention.

Figure 37 is a perspective view of a lift and carry device particularly well adapted for use with the seventeenth embodiment of the present invention.

Figure 38 is a schematic plan view of the seventeenth embodiment of this invention.

Figure 39-41 are schematic side views of the seventeenth embodiment of this invention in three successive positions during the loading cycle.

Definitions

As used herein, the following terms have the indicated meanings:

Lift and carry truck: A vehicle, whether self-propelled or towed, having the inherent capability of both lifting and carrying a load. Examples are forklift trucks and bucket loaders.

Ground-engaging transport means: any transport means mounted on the truck, engaging the ground, and moveable relative to the ground and the truck. Examples are wheels and treads.

Polygon of Normal Stability: the area over which the center of mass of a truck and a load carried by the truck can move without tilting the truck. For instance, the points at which the outer wheels of a conventional forklift truck make contact with the ground define its polygon of normal stability. If it is attempted to lift a load heavy enough so that the center of mass of the combined truck and load is located outside the polygon of normal stability, the truck will "nose over," tilting about the edge of the polygon of normal stability adjacent to the load until the load comes to rest on the ground.

Lift and carry device: any means mounted on the truck and adapted to grasp or support a load in order to lift and carry it. Examples are forklifts and buckets.

Stabilizer: any means mounted on the truck and moveable between a first position in which it engages the ground and a second position in which it does not engage the ground. Such devices are known per se and are also called "outriggers."

Load Position: Although loads carried by lift and carry trucks are typically voluminous as well as heavy, for purposes of rating such trucks, they are typically assumed to be concentrated at a point a given distance from a reference point or line. For instance, forklift trucks are rated according to their ability to lift and carry a load the center of gravity of which is located twenty-four inches in front of the heel of the forklift.

Detailed Descriptions of The Presently Preferred Embodiments

First Embodiment

The first embodiment is shown in Figures 1-8. It is a forklift truck comprising a body 10, four ground-engaging transport wheels 12 mounted on the body 10 and defining a polygon (in this case, a rectangle) of normal stability, a forklift 14 mounted on the body 10, first means 16 for moving the forklift 14 vertically and horizontally relative to the body 10 back and forth between a first position (shown in Figure 3) in which the center of gravity of the combined load and truck is or may be outside the polygon of normal stability and a second position (shown in Figure 4) in which the center of gravity of the combined load and truck is within the polygon of normal stability, at least one stabilizer (in this case, two stabilizers) 18 mounted on the body 10, and second means 20 for moving the stabilizers 18 vertically relative to the body 10 back and forth between a first position (shown in Figure 3) in which the stabilizers 18 engage the ground outside the polygon of normal stability and a second position (shown in Figure 4) in which the stabilizers 18 are retracted and do not interfere with movement of the forklift truck. As will be apparent, the stabilizer 18 can be extended outside of the polygon of normal stability to provide support for a load which is to be lifted by the forklift 14 and carried by the forklift truck, and the forklift 14 can be extended outside of the polygon of normal stability to lift a load up and into a carry position within the polygon of normal stability without use of a counterweight mounted on the body 10.

In this embodiment, the forklift 14 moves vertically and horizontally in two different motions, which can occur either concurrently or sequentially. The forklift 14 is mounted on a mast 22, and the first means 16 comprises third means 24 for moving the mast 22 horizontally relative to the

body 10 and fourth means 26 for moving the forklift 14 vertically relative to the mast 22. As best seen in Figure 6, the third means 24 comprises a plurality of wheels 28 mounted on the mast 22, at least one trackway (in this case, two trackways) 30 for the wheels 28 mounted on the body 10, and a hydraulic jack 32 operatively connected to the mast 22 at one end and to the body 10 at the other end. Preferably, the wheels 28 are mounted on a first dolly 29 which carries the mast.

The second means 20 each comprise a hydraulic jack 34 which is operatively connected to the body 10 at one end and to the associated stabilizer 18 at the other end. Additionally, this embodiment further comprises sixth means 36 for moving the stabilizer 18 horizontally relative to the body 10 back and forth between a first position (shown in Figure 6) in which the stabilizers 18 are relatively remote from the body 10 and a second position (shown in Figure 7) in which the stabilizers 18 are relatively close to the body 10. The sixth means comprises a double-ended hydraulic jack 38, each end of which is operatively connected to an associated one of the stabilizers 18 and activation of which causes the stabilizer 18 to move in opposite directions by equal amounts.

The stabilizers 18 preferably comprise elongated members the vertical dimension of which is sufficiently small to permit the stabilizers to be inserted into pallet voids, as shown in Figure 9, or under skids. When the stabilizer is in its ground-engaging position, it extends from a first point relatively remote from the body 10 in the direction of the load position to a second position relatively close to the body 10. The elongated member is pivotably mounted on the body 10, and the forklift truck further comprises fifteenth menas 40, such as a hydraulic motor, for pivoting the elongated member from a first, or use, position shown in Figures 1, 2, 3, 4, and 6 to a second, or carry, position shown in Figures 5 and 7 in which it is closer to the body 10.

As best seen in Figures 1 and 3, the forklift 14 comprises tines 42 extending outwardly from the body 10, shafts 44 extending at approximately a 90° angle from the tines 42, and heels 46 joining the tines 42 to the shafts 44. The forward edge of the stabilizers 18 engage the ground at least between the load position of the forklift 14 when it is in its extreme lift position and the polygon of normal stability. Preferably, the forward edge of the stabilizers 18 engage the ground between the forward face of the shafts 44 when the forklift 14 is in its extreme lift position and the polygon of normal stability; more preferably, between the heels 46 and the polygon of normal stability; and most preferably between the back of the shafts 44 and the polygon of normal stability. While in theory the further away from the polygon of normal stability the stabilizers 18 engage the ground the heavier a load the forklift truck will be able to lift and carry, in practice it has been found that designing the forklift truck so that the stabilizers 18 engage the ground just in front of the rearward surface of the shafts 44 when the forklift 14 is in its extreme lift position causes an enormous increase in the capacity of the forklift truck and that this increase is sufficient for most purposes.

The forklift truck further comprises an operator's station 48 mounted on the body 10 and seventh means 50 for moving the operator's station 48 from a first position (shown in solid lines in Figure 1) in which it extends above the body 10 by a first amount to a second position (shown in broken lines in Figure 1) in which it extends above the body by a second amount which is less than the first amount. The operator's station 48 is pivotally mounted on the body 10, and the seventh means 50 comprises a brace 52 which connects the operator's station 48 to the body 10 and which is pivotally connected at one end and releasably connected at the other. Release of the brace 52 permits the operator's station 48 to pivot

relative to the body 10 so that the operator's station 48 can be moved from its first position to its second position to facilitate storage of the forklift truck.

Similarly, eighth means 54 are provided for moving the mast 22 from a first position (shown in Figures 1 and 3) in which it extends above the body 10 by a first amount to a second position (shown in Figure 5) in which it extends above the body by a second amount which is less than the first amount, so that the mast 22 also can be moved from its first position to its second position to facilitate storage. As may be seen by comparing Figures 3 and 5, the mast 22 is pivotally mounted on the dolly 29, and the eighth means 54 is a hydraulic jack which extends between the mast 22 and the dolly 29. Activation of the hydraulic jack causes the mast 22 to pivot relative to the dolly 29.

Moreover, ninth means 56 are provided for moving the forklift 14 from a first position (shown in Figure 3) in which it extends outwardly from the mast 22 by a first amount to a second position (shown in Figure 5) in which it extends outwardly from the mast 22 by a second amount which is less than the first amount. This construction permits the forklift 14 to be moved from its first position to its second position to facilitate storage of the truck. In the first embodiment, the forklift 14 is removably mounted on the mast 22, and the ninth means 56 permits the forklift 14 to be removed from the mast 22 in its first position and replaced on the mast 22 in its second position.

Operation of the First Embodiment

The operation of the first embodiment is illustrated in Figure 9. As shown therein, the stabilizers 18 are preferably spaced outboard of the forklift tines 42. Accordingly, when the forklift tines 42 are inserted into one pallet in a linear array of pallets, the stabilizers 18 are inserted into adjacent pallets. Then, when the central pallet is lifted

by the forklift 14, the stabilizers remain in place in the adjacent pallets, preventing the forklift truck from nosing over without hampering the lifting of the central pallet.

Second Embodiment

The second embodiment is shown fragmentarily in Figure 10. It is identical to the first embodiment except that the forklift 14 is pivotally mounted on the mast 22 and the ninth means 56 permits the forklift 14 to be pivoted relative to the mast 22.

Third Embodiment

The third embodiment is shown schematically in Figure 11. It is identical to the first embodiment except that the third means 24 comprises a pantograph 58 operatively connected to the mast 22 at one end and to an upstanding portion of the body 10 at the other.

Fourth Embodiment

The fourth embodiment is shown schematically in Figure 12. It is identical to the third embodiment except that the first means 16 comprises fifth means 60 for moving the forklift 14 horizontally relative to the mast 22 and fourth means 26 for moving the forklift vertically relative to the mast 22. The fifth means 60 comprises a pantograph operatively connected to the forklift 14 at one end and to the mast 22 at the other end. The fourth means 26, although not visible in Figure 12, is identical to the fourth means 26 in the first embodiment, best seen in Figures 3 and 4.

Fifth Embodiment

The fifth embodiment is shown schematically in Figure 13. It is identical to the fourth embodiment except that the ninth means 56 comprises a parallelogram linkage 62

connecting the forklift 14 to the mast 22 and a hydraulic jack 64 one end of which is connected to the mast 22 and the other end of which is connected to the parallelogram linkage 62.

Sixth Embodiment

The sixth embodiment is shown schematically in Figure 14. It is identical to the fifth embodiment except that one leg 66 of the parallelogram linkage 62 is a hydraulic jack. This construction permits the forklift 14 to be tilted back relative to the mast 22.

Seventh Embodiment

The seventh embodiment is shown schematically in Figures 15 through 17. It is different from the embodiments previously discussed in that the forklift 14 moves vertically and horizontally in a single combined motion. The forklift 14 is mounted on a pair of spars 68 which are mounted longitudinally on the body 10 and which extend from a first end at a first end of the forklift truck to a second end spaced from the first end. The first means 16 comprises sixth means 70 for moving the forklift 15 relative to the spar 68. In this embodiment, the forklift 14 is mounted on sleeves 72 slidably carried by the spars 68, and the sixth means 70 comprises a hydraulic jack operatively connected at one end to the sleeves 72 and at the other end to the spars 68.

The forklift 14 is pivotally mounted on the spars 68 at 74, and the spars are pivotally mounted on the mast 22 at 76. Tenth means 78 comprising a hydraulic jack are provided to pivot the forklift 14 relative to the spars 68, eleventh means 80 comprising a hydraulic jack are provided to pivot the spars 68 relative to the body 10, and twelfth means 82 comprising a micro-processor or fluidic control circuitry are provided to coordinate the tenth and eleventh means to maintain the forklift 14 at a desired angle relative to the ground.

Eighth Embodiment

The eight embodiment is shown schematically in Figures 18 and 19. It is identical to the seventh embodiment except that the forklift 14 is mounted on a second dolly 84, the second dolly 84 is movably mounted on the spars 68, the sixth means 70 comprises a hydraulic jack operatively connected at one end to the second dolly 84 and at the other end to the spars 68, and the tenth means 78 comprises a hydraulic jack operatively connected at one end to the second dolly 84 and at the other end to the forklift 14.

Ninth Embodiment

The ninth embodiment is shown schematically in Figures 20 and 21. It is similar to the seventh and eight embodiments except that the spars 68 are replaced by a first trackway 86 mounted on the body 10 and extending from a first low end to a second end which is higher than the first end, the forklift 14 is carried by the second dolly 84, and the first means 16 causes the forklift 14 to move in the first trackway 86. In this embodiment, the first means 16 comprises a telescoping hydraulic jack 88 operatively connected at one end to the second dolly 84 and at the other end to the body 10. The forklift 14 is pivotally mounted on the second dolly 84 at 74, and the first trackway 86 is pivotally mounted on the body 10 at 76. Thirteenth means 90 comprising a hydraulic jack are provided for pivoting the forklift 14 relative to the second dolly 84, fourteenth means 92 comprising a hydraulic jack are provided for pivoting the first trackway 86 relative to the body 10, and twelfth means 82 comprising a microprocessor or fluid control circuitry are provided to coordinate the thirteenth and fourteenth means to maintain the forklift 14 at a desired angle relative to the ground.

Tenth Embodiment

The tenth embodiment is shown schematically in Figures 22 through 24. This embodiment comprises a first trackway 86 mounted on the body 10 and extending from a first low end to a second end which is higher than the first end and a second trackway 94 mounted elsewhere on the body 10. The forklift 14 is movably received in the first trackway 86, and a third dolly 96 is movably received in the second trackway 94. A brace 98 connects the forklift 14 to the third dolly 96, and sixteenth means 100 comprising a hydraulic jack operably connected at one end to the third dolly 96 and at the other end to the body 10 are provided for moving the third dolly 96 relative to the body 10. The stabilizer 18 is pivotably mounted on the third dolly 96 at 102, and seventeenth means 104 are provided for pivoting the stabilizer 18 relative to the third dolly 96. The means 104 preferably comprises hydraulic jacks each of which is operatively connected at one end to the associated third dolly 96 and at the other end to the associated stabilizer 18.

The most of operation of the tenth embodiment is illustrated in Figures 25 through 27. In Figure 25, the third dolly 96 is at the front of the second trackway 94, the stabilizer 18 has been lowered into contact with the ground, and a load is being picked up by the forklift 14. In Figure 26, the third dolly 96 has been brought to the rear of the second trackway 94, bringing the load position closer to or within the polygon of normal stability, while the stabilizer 18 has remained in contact with the ground at the same place (note the relative movement of the stabilizer 18 and the ground engaging wheel 12 between Figures 25 and 26). In Figures 27, the stabilizer 18 has been pivoted out of contact with the ground, and the truck is now ready to transport the load.

Eleventh Embodiment

The eleventh embodiment is shown schematically in Figure 28. It differs from the previous embodiments with

respect to the stabilizer 18. This embodiment of the stabilizer 18 can be used with all the previous embodiments except the tenth embodiment.

In this embodiment, the stabilizers 18 are pivotally mounted on the body 10 at 106, and eighteenth means 108 are provided for pivoting each of the stabilizer 18 relative to the body 10. The eighteenth means 108 comprises hydraulic jack operatively connected at one end to the stabilizer 18 and at the other end to the body 10.

Twelfth Embodiment

The twelfth embodiment is shown schematically in Figure 29. It is kinematically identical to the eleventh embodiment except that the hydraulic jack 108 retracts to lift the stabilizer 18 from its ground engaging position rather than extends, as it does in the eleventh embodiment.

Thirteenth Embodiment

The thirteenth embodiment is shown schematically in Figure 30. It is similar to the eleventh embodiment except that a single stabilizer 18 is centrally mounted on the body 10. This embodiment is particularly useful in configurations in which the lift and carry device is a bucket. In such configuration, the bucket may actually contact the stabilizer when it is scooping up a load. However, this embodiment is also useful in configurations in which the lift and carry device is a forklift, particularly to lift a load carried on a skid which has other skids on either side of the load to be lifted.

Fourteenth Embodiment

The fourteenth embodiment is shown schematically in Figures 31 and 32. In this embodiment, a single, centrally mounted stabilizer 18 is connected to the body 10 by two spaced scissors linkages 110. The utility of this embodiment is similar to that of the thirteenth embodiment.

Fifteenth Embodiment

The fifteenth embodiment is shown schematically in Figures 33 through 35. It differs from the previous embodiment in that apparatus is provided for stowing the lift and carry truck on a cargo truck. The embodiment of the lift and carry truck shown in Figures 33 through 35 is the first embodiment, but it will be recognized that the stowing apparatus could be used with any lift and carry truck and is particularly well adapted for any lift and carry truck which collapses vertically for storage.

Figures 33 through 35 shows this embodiment in use on a flatbed trailer, which has a substantial amount of vertical open space beneath the flatbed 200. The apparatus comprises at least two winches 202 mounted on either the flatbed 200 or the lift and carry truck and lines 204 connecting the winches 202 to the other of the flatbed 200 or the lift and carry truck. In the illustrated embodiment, a single winch 202 is mounted at either end of the lift and carry truck, but the winches could be mounted on the flatbed 200 rather than on the lift and carry truck, and four winches could be used -- one at each corner of the generally rectangular body of the usual lift and carry truck. However, since the lift and carry trucks is held flat against the planar undersurfaces of the flatbed 200, two winches 202 have been found sufficient in practice.

Sixteenth Embodiment

The sixteenth embodiment is shown schematically in Figure 36. It is identical to the fifteenth embodiment except that it is adapted for use with a cargo truck in which power is supplied to the rear wheels by means which fill up the space beneath the bed of the truck. Accordingly, two spaced beams are mounted projecting from the rear of the cargo truck, and the lift and carry truck is stowed beneath the beams.

Seventeenth Embodiment

A lift and carry device 300 particularly well adapted for use with the seventeenth embodiment is shown in Figure 37. It comprises a crossbar 302, a plurality of tines 304 mounted on the crossbar 302, a plurality of stabilizers 306 mounted for vertical movement relative to the crossbar 302, and means 308 comprising a pair of hydraulic jacks for moving the stabilizers 306 relative to the crossbar 302. In this embodiment, the tines 304 are fixedly mounted on the crossbar 302 and the stabilizers 306 are slidably received in the crossbar 302, but it will be appreciated that other embodiments are possible, including one in which the tines and crossbar are constructed integrally as a conventional forklift and the stabilizers are received in external ways on the forklift.

In use, initial actuation of the hydraulic cylinders 308 causes the stabilizers 306 to extend relative to the crossbar 302 until they come into contact with the ground. Subsequent actuation of the hydraulic cylinders 308 causes the crossbar 302 to move vertically relative to the stabilizers 306. Since the tines 304 are mounted on the crossbar 302, they and any load carried by them are lifted vertically along with the crossbar 302.

The particular advantage of this embodiment of the lift and carry device is that only a single set of hydraulic jacks is required both to emplace the stabilizers and to lift the lift and carry device. However, it will be appreciated that the fact that the stabilizers must be kept in contact with the ground in order to keep the lift and carry device in the air means that certain adaptations have to be made in the relationship between the lift and carry device and the lift and carry truck. One possibility would be to put wheels on the stabilizers 306, allowing the lift and carry device to be brought back over the polygon of normal stability, as in all of the preceding embodiments

except the tenth embodiment. Another possibility, shown in Figures 38 through 41, is to enlarge the polygon of normal stability after the load is in the air so that the raised load is over the polygon of normal stability, after which the lift and carry device can be lowered onto the lift and carry truck and the stabilizer raised out of contact with the ground.

Figures 38 through 41 show the lift and carry device 300 mounted on a lift and carry truck 310. The lift and carry truck 310 comprises a relatively heavy rear portion 312 having rear wheels 314, a relatively light front portion 316 having front wheels 318 telescopically received in the rear portion 312, means 320 comprising a pair of hydraulic jacks for moving the front portion 316 relative to the rear portion 312, and means 322 for mounting the lift and carry device 300 for vertical movement relative to the rear portion 312. In this embodiment, the means 322 comprise a pair of upright standards 324 stepped at 326, a collar 328 slidably mounted on the upper portion of the upright standards 324, and braces 330 connecting the crossbars 302 to the collars 328..

In operation, the hydraulic jacks 308 are retracted to lift the stabilizers 306 out of contact with the ground, the step 326 preventing the lift and carry device 300 from sliding downwardly on the standards 324. Initial actuation of the hydraulic jacks 308 causes the stabilizer 306 to make contact with the ground, and subsequent actuation of the hydraulic jacks 308 causes the crossbar 302 to move vertically upwardly relative to the stabilizer 306 and the collars 328 to move vertically upwardly relative to the standards 324, as shown in Figure 39. Next, the hydraulic jacks 320 are actuated to extend the polygon of normal stability so that the load position of the lift and carry device 300 is over the polygon of normal stability, as shown in Figure 40. Finally, the hydraulic jacks 308 are retracted, first allowing the lift and carry device 300 to settle down onto the lift and carry truck 310 and then lifting the stabilizers 306 out of contact with the ground.

As will be appreciated, means must be provided to ensure that actuation of the hydraulic jacks 320 causes the front portion 316 of the lift and carry truck 310 to move forwardly relative to the rear portion 312 rather than causing the rear portion 312 to move rearwardly relative to the front portion 316. While various kinds of ground-engaging anchors could be provided, it is believed that simply ensuring that the rear portion 312 is much heavier than the front portion 316 will be adequate for this purpose.

Caveat

While the present invention has been illustrated by detailed descriptions of a number of preferred embodiments thereof, it will be obvious to those skilled in the art that various changes in form and detail can be made therein without departing from the true scope of the invention. For that reason, the invention must be measured by the claims appended hereto and not by the foregoing preferred embodiments.

WHAT IS CLAIMED IS:

1. A lift and carry truck comprising:

(a) a body;

(b) a plurality of ground engaging transport means mounted on said body, said means defining a polygon of normal stability;

(c) a lift and carry device mounted on said body;

(d) first means for moving said lift and carry device vertically and horizontally relative to said body back and forth between a first, or lift, position in which the center of gravity of the combined load and truck is or may be outside the polygon of normal stability and a second, or carry, position in which the center of gravity of the combined load and truck is within the polygon or normal stability;

(e) at least one stabilizer mounted on said body; and

(f) second means for moving said stabilizer vertically relative to said body back and forth between a first position in which said stabilizer engages the ground outside the polygon of normal stability and a second position in which said stabilizer is retracted and does not interfere with movement of the lift and carry truck, whereby said stabilizer can be extended outside of the polygon of normal stability to provide support for a load which is to be lifted by said lift and carry device and carried by the lift and carry truck, and said lift and carry device can be extended until its load position is outside of the polygon of normal stability to

lift a load up and into a carry position in which its load position is within the polygon of normal stability without use of a counterweight mounted on said body.

2. A lift and carry truck as recited in claim 1 wherein said lift and carry device moves vertically and horizontally in two different motions.

3. A lift and carry truck as recited in claim 2 wherein:
   (a) said lift and carry device is mounted on a mast and
   (b) said first means comprises:
      (i) third means for moving said mast horizontally relative to said body and
      (ii) fourth means for moving said lift and carry device vertically relative to said mast.

4. A lift and carry truck as recited in claims 3 or 10 wherein said third means comprises:
   (a) a plurality of wheels mounted on said mast and
   (b) at least one trackway for said wheels mounted on said body.

5. A lift and carry truck as recited in claims 3, 4, or 10 wherein said third means comprise a hydraulic jack operatively connected to said mast at one end and to said body at the other end.

6. A lift and carry truck as recited in claims 3 or 4 wherein said third means comprises a pantograph operatively connected to said mast at one end and to said body at the other.

7. A lift and carry truck as recited in claim 2 wherein:
   (a) said lift and carry device is mounted on a mast and
   (b) said first means comprises:

(i) fifth means for moving said lift and carry device horizontally relative to said mast and

(ii) fourth means for moving said lift and carry device vertically relative to said mast.

8. A lift and carry truck as recited in claim 7 wherein said fifth means comprises a pantograph operatively connected to said lift and carry device at one end and to said mast at the other end.

9. A lift and carry truck as recited in claim 1 wherein said second means comprises at least one hydraulic jack which is operatively connected to said body at one end and to said at least one stabilizer at the other end.

10. A lift and carry truck as recited in claims 1 or 9 and further comprising sixth means for moving said stabilizer horizontally relative to said body back and forth between a first position in which said stabilizer is relatively remote from said body and a second position in which said stabilizer is relatively close to said body.

11. A lift and carry truck as recited in claim 10 and comprising two of said stabilizers mounted on said bed.

12. A lift and carry truck as recited in claim 11 wherein said sixth means causes said stabilizers to move in opposite directions by equal amounts.

13. A lift and carry truck as recited in claim 12 wherein said sixth means comprises a hydraulic jack each end of which is operatively connected to an associated one of said stabilizers.

14. A lift and carry truck as recited in claim 1 and further comprising:

(a) an operator's station mounted on said body and

(b) seventh means for moving said operator's station from a first position in which it

extends above said body by a first amount to a second position in which it extends above said body by a second amount which is less than the first amount,

whereby said operator's station can be moved from its first position to its second position to facilitate storage of the lift and carry truck.

15. A lift and carry truck as recited in claim 14 wherein:

(a) said operator's station is pivotably mounted on said body and

(b) said seventh means permits said operator's station to pivot relative to said body.

16. A lift and carry truck as recited in claim 15 wherein said seventh means comprise a brace which connects said operator's station to said body, said brace being pivotably connected at one end and releasably connected at the other end.

17. A lift and carry truck as recited in claim 3 and further comprising eighth means for moving said mast from a first position in which it extends above said body by a first amount to a second position in which it extends above said body by a second amount which is less than the first amount, whereby said mast can be moved from its first position to its second position to facilitate storage of the lift and carry truck.

18. A lift and carry truck as recited in claim 17 wherein:

(a) said mast is pivotably mounted on said body and

(b) said eighth means causes said mast to pivot relative to said body.

19. A lift and carry truck as recited in claim 3 wherein said third means comprises:

(a) a first dolly;

(b) a plurality of wheels mounted on said first dolly; and

(c) at least one trackway for said wheels mounted on said body.

20. A lift and carry truck as recited in claim 19 wherein said third means further comprises a hydraulic jack operatively connected to said first dolly at one end and to said body at the other end.

21. A lift and carry truck as recited in claim 18 wherein said eighth means comprises a hydraulic jack operatively connected to said mast at one end and to said first dolly at the other end.

22. A lift and carry truck as recited in claim 3 and further comprising ninth means for moving said lift and carry device from a first position in which it extends outwardly from said mast by a first amount to a second position in which it extends outwardly from said mast by a second amount which is less than the first amount, whereby said lift and carry device can be moved from its first position to its second position to facilitate storage of the lift and carry truck.

23. A lift and carry truck as recited in claim 22 wherein:

(a) said lift and carry device is pivotably mounted on said mast and

(b) said ninth means permits said lift and carry device to be pivoted relative to said mast.

24. A lift and carry truck as recited in claim 22 wherein:

(a) said lift and carry device is removably mounted on said mast and

(b) said ninth means permits said lift and carry device to be removed from said mast in its first position and replaced on said mast in its second position.

25. A lift and carry truck as recited in claim 22 wherein said ninth means comprises:
(a) a parallelogram linkage connecting said lift and carry device to said mast and
(b) a hydraulic jack one end of which is connected to said mast and one end of which is connected to said parallelogram linkage.

26. A lift and carry truck as recited in claim 25 wherein one leg of said parallelogram linkage comprises a hydraulic jack, whereby said lift and carry device can be tilted back relative to said mast.

27. A lift and carry truck as recited in claim 1 wherein said lift and carry device moves vertically and horizontally in a single combined motion.

28. A lift and carry truck as recited in claim 27 wherein:
(a) said lift and carry device is mounted on a spar which is mounted longitudinally on said body and which extends from a first end at a first end of the lift and carry truck to a second end spaced from the first end and
(b) said first means comprises sixth means for moving said lift and carry device relative to said spar.

29. A lift and carry truck as recited in claim 28 wherein said sixth means comprises a hydraulic jack operatively connected at one end to said lift and carry device and at the other end to said spar.

30. A lift and carry truck as recited in claim 28 wherein:
(a) said lift and carry device is mounted on a sleeve;
(b) said sleeve is movably mounted on said spar; and
(c) said sixth means comprises a hydraulic jack operatively connected at one end to said sleeve and at the other end to said spar.

31. A lift and carry truck as recited in claim 28 wherein:
(a) said lift and carry device is pivotably mounted on said spar;

(b) said spar is pivotably mounted on said body; and

(c) the lift and carry truck further comprises:

(i) tenth means for pivoting said lift and carry device relative to said spar;

(ii) eleventh means for pivoting said spar relative to said body; and

(iii) twelfth means for coordinating said tenth and eleventh means to maintain said lift and carry device at a desired angle relative to the ground.

32. A lift and carry truck as recited in claim 31 wherein:

(a) the lift and carry truck further comprises a mast mounted on said body and

(b) said spar is pivotably mounted on said mast.

33. A lift and carry truck as recited in claim 31 wherein:

(a) said lift and carry device is mounted on a sleeve;

(b) said sleeve is movably mounted on said spar; and

(c) said fourth means comprises a hydraulic jack operatively connected at one end to said sleeve and at the other end to said lift and carry device.

34. A lift and carry truck as recited in claim 31 wherein said eleventh means comprises a hydraulic jack operatively connected at one end to said spar and at the other end to said body.

35. A lift and carry truck as recited in claim 28 wherein:

(a) said lift and carry device is mounted on a second dolly;

(b) said second dolly is movably on said spar; and

(c) said sixth means comprises a hydraulic jack operatively connected at one end to said dolly and at the other end to said spar.

36. A lift and carry truck as recited in claim 31 wherein:

(a) said lift and carry device is mounted on a second dolly;

(b) said second dolly is movably mounted on said spar; and

(c) said tenth means comprises a hydraulic jack operatively connected at one end to said second dolly and at the other end to said lift and carry device.

37. A lift and carry truck as recited in claim 27 wherein:

(a) a first trackway is mounted on said body and extends from a first low end to a second end which is higher than the first end;

(b) a second dolly is movably mounted in said trackway;

(c) said lift and carry device is carried by said second dolly; and

(d) said first means causes said lift and carry device to move in said first trackway.

38. A lift and carry truck as recited in claim 37 wherein said first means comprises a hydraulic jack operatively connected at one end to said second dolly and at the other end to said body.

39. A lift and carry truck as recited in claim 37 wherein:

(a) said lift and carry device is pivotably mounted on said second dolly;

(b) said first trackway is pivotably mounted on said body; and

(c) the lift and carry truck further comprises:

(i) thirteenth means for pivoting said lift and carry device relative to said second dolly;

(ii) fourteenth means for pivoting said first trackway relative to said body; and

(iii) twelfth means for coordinating said thirteenth and fourteenth means.

40. A lift and carry truck as recited in claim 27 wherein:

(a) a first trackway is mounted on said body and extends from a first low end to a second end which is higher than the first end;

(b) said lift and carry device is movably received in said first trackway;

(c) a second trackway is mounted on said body;

(d) a third dolly is movably received in second trackway;

(e) a brace is connected to said lift and carry device at one end and to said third dolly at the other end; and

(f) sixteenth means are provided for moving said third dolly relative to said body.

41. A lift and carry device as recited in claim 40 wherein said sixteenth means comprises a hydraulic jack operatively connected at one end to said third dolly and at the other end to said body.

42. A lift and carry device as recited in claim 40 wherein said stabilizer is pivotably mounted on said third dolly and further comprising seventeenth means for pivoting said stabilizer relative to said third dolly.

43. A lift and carry device as recited in claim 42 wherein said seventeenth means comprises a hydraulic jack operatively connected at one end to said third dolly and at the other end to said stabilizer.

44. A lift and carry truck as recited in claim 1 wherein said stabilizer comprises an elongated member which, when said stabilizer is in its ground engaging position, extends from a first point relatively remote from said body in the direction of the load position to a second point relatively close to said body, the vertical dimension of said stabilizer being sufficiently small to permit said stabilizer to be inserted into a pallet void.

45. A lift and carry truck as recited in claim 44

(a) wherein said elongated member is pivotably mounted on said body and

(b) further comprising fifteenth means for pivoting said elongated member from a first, or use, position in which it extends outwardly from said body toward the load position to a second, or carry position, in which it is closer to said body.

46. A lift and carry truck as recited in claim 45 wherein said fifteenth means is a hydraulic motor.

47. A lift and carry truck as recited in claim 1 wherein:

(a) said lift and carry device is a forklift having tines extending outwardly from said body, shafts extending at approximately a 90° angle from said tines, and heels joining said tines to said shafts and

(b) the forward edge of said stabilizer engages the ground between the load position of said forklift when the forklift is in its extreme lift position and the polygon of normal stability.

48. A lift and carry truck as recited in claim 47 wherein the forward edge of said stabilizer engages the ground between the forward face of said shafts when the forklift is in its extreme lift position and the polygon of normal stability.

49. A lift and carry truck as recited in claim 48 wherein the forward edge of said stabilizer engages the ground between said heels when the forklift is in its extreme lift position and the polygon of normal stability.

50. A lift and carry truck as recited in claim 49 wherein the forward edge of said stabilizer engages the ground between the rearward face of said shafts when the forklift is in its extreme lift position and the polygon of normal stability.

51. A lift and carry truck as recited in claim 1 wherein:

(a) said lift and carry device is a forklift having tines extending outwardly from said body, shafts extending at approximately a 90° angle from said tines, and heels joining said tines to said shafts and

(b) the forward edge of said stabilizer engages the ground outside the polygon of normal stability.

52. A lift and carry truck as recited in claim 51 wherein the forward edge of said stabilizer engages the ground just in front of the rearward surface of said shafts when said forklift is in its extreme lift position.

53. A lift and carry truck as recited in claim 52 wherein the forward edge of said stabilizer engages the ground in front of said heels when said forklift is in its extreme lift position.

54. A lift and carry truck as recited in claim 53 wherein the forward edge of said stabilizer engages the ground in front of the forward surface of said shafts when said forklift is in its extreme lift position.

55. A lift and carry truck as recited in claim 54 wherein the forward edge of said stabilizer engages the ground in front of the load position of said forklift when said forklift is in its extreme lift position.

56. A lift and carry truck as recited in claim 1

(a) wherein said stabilizer is pivotably mounted on said body and

(b) further comprising eighteenth means for pivoting said stabilizer relative to said body.

57. A lift and carry truck as recited in claim 56 wherein said eighteenth means comprise a hydraulic jack operatively connected at one end to said stabilizer and at the other end to said body.

58. A lift and carry truck as recited in claim 1 wherein a single stabilizer is centrally mounted on said body.

59. A lift and carry truck as recited in claim 58 wherein said stabilizer is connected to said body by a scissors linkage.

60. Apparatus for stowing a lift and carry truck on a cargo truck, said apparatus comprising:

(a) at least two winches mounted on one of said lift and carry truck and said cargo truck and

(b) lines connecting said winches to the other of said lift and carry truck and said cargo truck,

whereby said lift and carry truck can be lifted and held against said cargo truck by means of said winches.

61. Apparatus as recited in claims 60 or 64 wherein a single winch is located at either end of said lift and carry truck when it is in its stowed position.

62. Apparatus as recited in claim 61 wherein said winches are mounted on said lift and carry truck.

63. Apparatus as recited in claim 60 wherein said apparatus is adapted to stow said lift and carry truck beneath the body of said cargo truck.

64. Apparatus as recited in claim 60 and further comprising two spaced beams adapted to be mounted projecting from the rear of said of cargo truck, whereby said apparatus is adapted to stow said lift and carry trucks beneath said beams.

65. A lift and carry truck as recited in claim 1 wherein:

(a) said body is divided into first and second portions which move telescopically relative to each other;

(b) at least one of said ground engaging transport means is mounted on each of said portions of said body;

(c) said lift and carry device is mounted on a first one of said portions of said body; and

(d) nineteenth means are provided for moving said second portion of said body relative to said first portion of said body to extend the polygon of normal stability.

66. A lift and carry truck as recited in claim 65 wherein said lift and carry device comprises:

(a) a crossbar;

(b) at least one tine mounted on said crossbar;

(c) at least one stabilizer mounted for vertical movement relative to said crossbar; and

(d) twentieth means for moving said stabilizer relative to said crossbar.

67. A lift and carry truck as recited in claim 66 wherein said twentieth means is a hydraulic jack.

68. A lift and carry truck as recited in claim 69 wherein said tine is fixedly mounted on said crossbar and said stabilizer is slidably received in said crossbar.

69. A lift and carry truck as recited in claim 65 wherein said nineteenth means is a hydraulic jack.

70. A lift and carry truck as recited in claim 65 wherein said lift and carry device is mounted for vertical movement relative to said body.

FIG.1

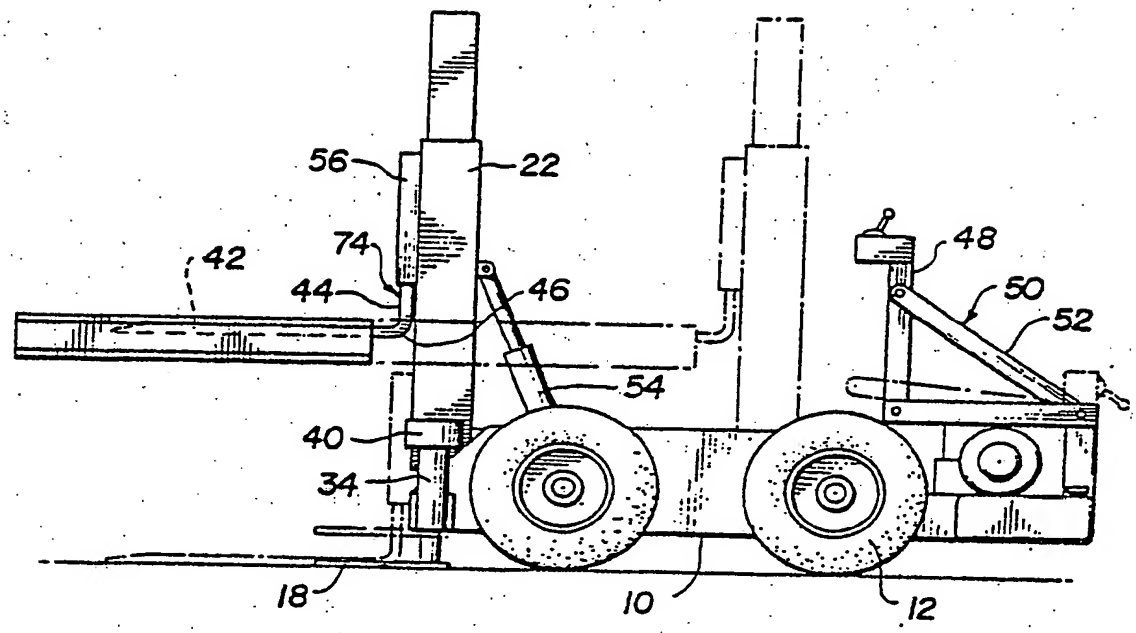

FIG.2